



W91321-04-C-0023

LOGANEnergy Corp.

Sierra Army Depot PEM Demonstration Project  
Initial Project Report

Proton Exchange Membrane (PEM) Fuel Cell Demonstration  
Of Domestically Produced PEM Fuel Cells in Military Facilities

US Army Corps of Engineers  
Engineer Research and Development Center  
Construction Engineering Research Laboratory  
Broad Agency Announcement CERL-BAA-FY03

Sierra Army Depot, Herlong, CA

August 28, 2004

## **Executive Summary**

Under terms of its FY'03 DOD PEM Demonstration Contract with ERDC/CERL, LOGANEnergy will install and operate a Plug Power GenSys 5kW<sub>e</sub> Combined Heat and Power fuel cell power plant at Sierra Army Depot, Herlong, CA. The site selected for the one-year demonstration project is Barracks Building #27.

This site was previously awarded to another contractor under the CERL BAA FY01 PEM program. In the original plan the integration of a SynDex heat pump with the fuel cell to improve upon its thermal utilization characteristics was an important area of investigation. However, as the contractor encountered various mechanical/thermal integration difficulties in the installation plus the failure of the H-Power fuel cell product to perform adequately, the project was terminated before its conclusion, and the site restored to its original condition.

Under this project revival, the unit will be electrically configured to provide grid parallel/grid independent service to the site, and it will also be thermally integrated with a SynDex heat pump to provide supplemental heating and cooling to Building #27 during the test period. The methodologies to accomplish these tasks are found in the paragraphs that follow. Local electrical and mechanical contractors will be hired to provide services as needed to support the installation tasks. It is anticipated that the project will add \$2,275 annual energy costs to Sierra Army Depot during the period of performance.

The POC for this project is Larry Duncan whose coordinates are:

[lduncan@sierra.army.mil](mailto:lduncan@sierra.army.mil)

530.827.4343

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## **Proposal – Proton Exchange Membrane (PEM) Fuel Cell Demonstration of Domestically Produced Residential PEM Fuel Cells in Military Facilities**

### **1.0 Descriptive Title**

LOGANEnergy Corp. Small Scale PEM 2004 Demonstration Project at Sierra Army Depot, Herlong, CA

### **2.0 Name, Address and Related Company Information**

LOGANEnergy Corporation

1080 Holcomb Bridge Road  
BLDG 100- 175  
Roswell, GA 30076  
(770) 650- 6388

DUNS 01-562-6211  
CAGE Code 09QC3  
TIN 58-2292769

LOGANEnergy Corporation is a private Fuel Cell Energy Services company founded in 1994. LOGAN specializes in planning, developing, and maintaining fuel cell projects. In addition, the company works closely with manufacturers to implement their product commercialization strategies. Over the past decade, LOGAN has analyzed hundreds of fuel cell applications. The company has acquired technical skills and expertise by designing, installing and operating over 30 commercial and small-scale fuel cell projects totaling over 7 megawatts of power. These services have been provided to the Department of Defense, fuel cell manufacturers, utilities, and other commercial customers. Presently, LOGAN supports 30 PAFC and PEM fuel cell projects at 21 locations in 12 states, and has agreements to install 22 new projects in the US and the UK over the next 18 months.

### **3.0 Production Capability of the Manufacturer**

Plug Power manufactures a line of PEM fuel cell products at its production facility in Latham, NY. The facility produces three lines of PEM products including the 5kW GenSys5C natural gas unit, the GenSys5P LP Gas unit, and the GenCor 5kW standby power system. The current facility has the capability of manufacturing 10,000 units annually. Plug will support this project by providing remote monitoring, telephonic field support, overnight parts supply, and customer support. These services are intended to enhance the reliability and performance of the unit and achieve the highest possible customer satisfaction. Scott Wilshire is the Plug Power point of contact for this project. His phone number is 518.782.7700 ex1338, and his email address is [scott\\_wilshire@plugpower.com](mailto:scott_wilshire@plugpower.com).

#### 4.0 Principal Investigator(s)

Name	Samuel Logan, Jr.	Keith Spitznagel
Title	President	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388 x 101	860.210.8050
Fax	770.650.7317	770.650.7317
Email	<a href="mailto:samlogan@loganenergy.com">samlogan@loganenergy.com</a>	<a href="mailto:kspitznagel@loganenergy.com">kspitznagel@loganenergy.com</a>

#### 5.0 Authorized Negotiator(s)

Name	Samuel Logan, Jr.	Keith Spitznagel
Title	President	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388 x 101	860.210.8050
Fax	770.650.7317	770.650.7317
Email	<a href="mailto:samlogan@loganenergy.com">samlogan@loganenergy.com</a>	<a href="mailto:kspitznagel@loganenergy.com">kspitznagel@loganenergy.com</a>

#### 6.0 Past Relevant Performance Information

##### a) Contract: PC25 Fuel Cell Service and Maintenance Contract #X1237022

Merck & Company  
Ms. Stephanie Chapman  
Merck & Company  
Bldg 53 Northside  
Linden Ave. Gate  
Linden, NJ 07036  
(732) 594-1686

Four-year PC25 PM Services Maintenance Agreement...

In November 2002 Merck & Company issued a four-year contract to LOGAN to provide fuel cell service, maintenance and operational support for one PC25C fuel cell installed at their Rahway, NJ plant. During the contract period the power plant has operated at 94% availability.

##### b) Contract: Plug Power Service and Maintenance Agreement to support one 5kWe GenSys 5C and one 5kWe GenSys 5P PEM power plant at NAS Patuxant River, MD. .

Plug Power  
Mr. Scott Wilshire.  
968 Albany Shaker Rd.  
Latham, NY 12110  
(518) 782-7700 ex 1338

- c) Contract: A Partners LLC Commercial Fuel Cell Project Design, Installation and 5-year service and maintenance agreement on 600kW UTC PC25 power block.  
Contract # A Partners LLC, 12/31/01

Mr. Ron Allison  
A Partner LLC  
1171 Fulton Mall  
Fresno, CA 93721  
(559) 233-3262

## 6.0 Host Facility Information



The mission of Sierra Army Depot is to provide US armed forces with rapid deployment of the best quality equipment and supplies from Sierra Army Depot to anywhere in the world. To provide maintenance, storage, logistical and training support (to Active, Reserve, National Guard) for all assets managed which include Operational Project Stocks for Deployable Medical Systems, Medical Supplies, Petroleum, Water Systems, Aviation Systems.

The Sierra Army Depot is located at Herlong, California, in sparsely populated Lassen County's Honey Lake Valley, which lies nestled in the northeastern foothills of the Sierra Nevada Mountains. Reno, NV (metro population approximately 250,000), is 55 miles Southeast of the depot via Highway 395 South. Susanville, California (metro population approximately 17,500), is 35 miles Northwest of the depot via Highway 395 North.



## 8.0 Fuel Cell Site Information

Pictured below are photos of the east and north elevations, respectively, of Building #27 that serves as a barracks for personnel stationed at Sierra Army Depot. The Plug Power Gensys5P PEM fuel cell will be installed on a pad that will be located in the foreground of the photo of the north elevation. In addition, a 500-gallon LP Gas tank that will provide fuel for the fuel cell and SynDex/compressor/heat pump unit integration will also be situated adjacent to the fuel cell. The LPGas unit will operate nominally at a power set point of 2.5kW(e) consuming .53 gallons of LP Gas per operating hour. At this rate the unit will operate at an electrical efficiency of 20% based on the propane reforming characteristics of the Lorax 4.5 reformer in this product. In order to boost the overall site economics, optimal thermal recovery practices will figure very importantly in the project. Paragraph 10.0 below describes in some detail the methodology the project will pursue to capture as much waste heat as possible. If the site achieves 58% thermal efficiency, LOGAN estimates the operating cost reduction will approximate \$0.29/kWh. However, given that the cost of LP Gas exceeds \$1.10 per Therm, and the unit's electrical efficiency is quite low by most power generating standards, the project must focus on the integration and characterization of untested ancillary systems to show how the product could operate in off-grid applications where cost accounting is not the significant issue. At this planning stage LOGAN does believe it will encounter any permitting issues in developing this site. The Sierra POC has indicated that both telephone and high-speed DSL communications will be available to the site.



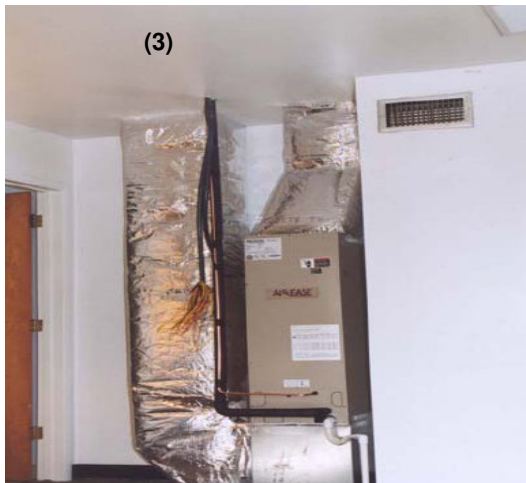
## 9.0 Electrical System

The Plug Power GenSys 5C PEM fuel cell power plant provides both grid parallel and grid independent operating configurations for site power management. This capability is an important milestone in the development of the Gensys5 product on the pathway to product commercialization. The unit has a power output of 110/120 VAC at 60 Hz, and when necessary the voltage can be adjusted to 208vac or 220vac depending upon actual site conditions. The fuel cell will be connected in parallel with the Sierra grid feed to the facility via a new 50-amp circuit breaker that LOGAN will install in the building's existing service panel. In addition, a separate grid-independent emergency panel will be installed to provide service to dedicated loads in the event of a failure of the utility grid feed to the site. While operating at 2.5kW(e) the unit provides nominally 27-30 amps of power to the effected circuits. The SynDex system may be electrically connected to the emergency panel provided its load demands do not exceed the fuel cell's grid independent capacity.



## 10.0 Thermal Recovery System

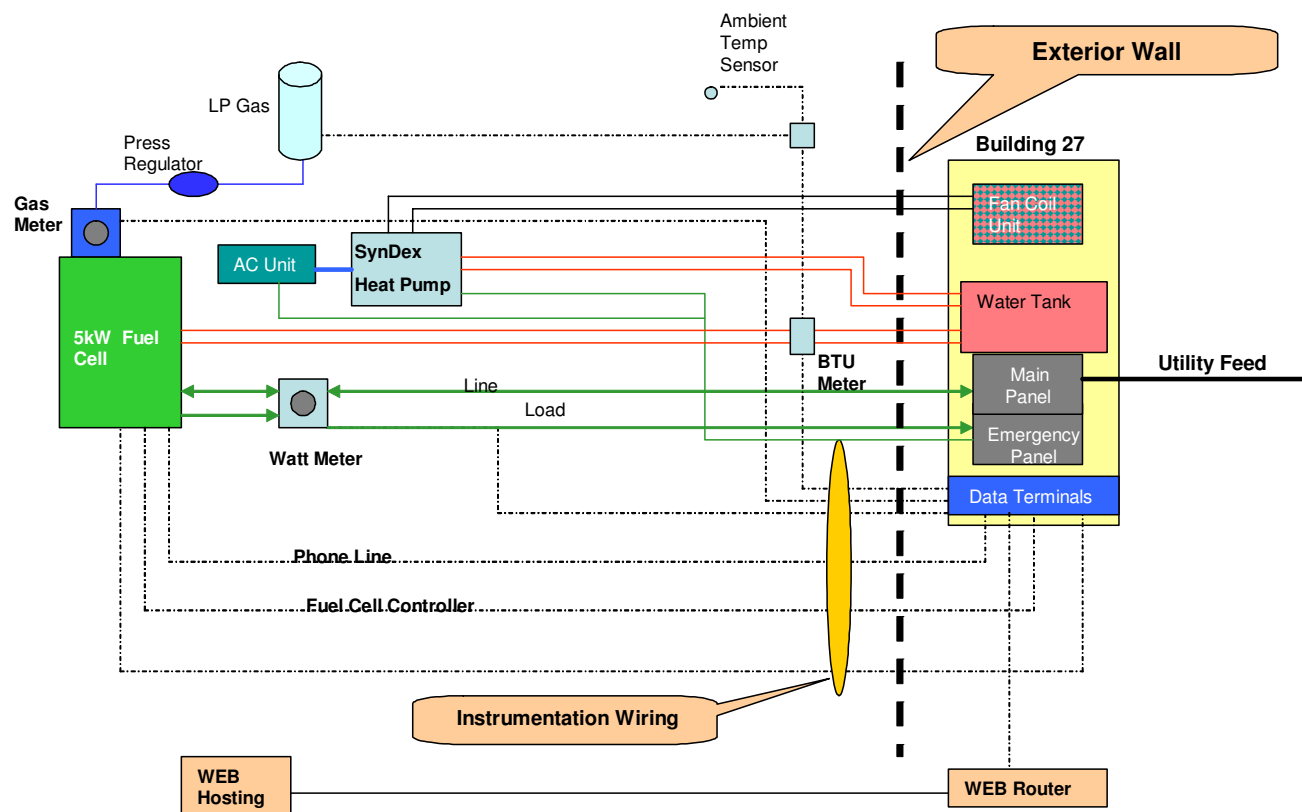
Since a SynDex heat pump is available to use with the project, LOGAN intends to integrate it with a with a residential air conditioning unit to provide heating and cooling to the barracks building, similar to the method pictured picture in photo (1) below. During the summer months, the air conditioning unit will provide supplemental cooling via the SynDex Freon loop to the fan coils in the building's HVAC system. During the winter months, a hot water heater will serve as a heat sink not only for domestic hot water but also to supplement thermal Btus to support winter heating loads. To accomplish this, thermal Btus from the fuel cell will be transferred to the water heater through a Heliodyne heat exchanger similar to the one in photo (2) below. The Heliodyne is a looped coil within a coil design that provides double wall protection between the heat source and the heat sink. It was designed primarily for the solar heating industry, but has proved to be very adaptable to the fuel cell industry as well. The Heliodyne will mount either directly to the storage tank or on an adjacent wall. It has its own pump that circulates the storage tank in a counter flow against incoming hot water provided by the fuel cell's heat exchanger. While operating at a set point of 2.5 kWh, the fuel cell provides 7800 Btuh to the storage tank at approximately 140 degrees F. A separate external heat exchanger will transfer Btus from the tank to the SynDex Freon loop, and then to the heat coils located in the HVAC duct within Building #27 seen in photo (3) below. The line diagram below illustrates the various methods and means to accomplish these tasks.





## Installation One Line of Electrical, Mechanical, Thermal, and Communications Design

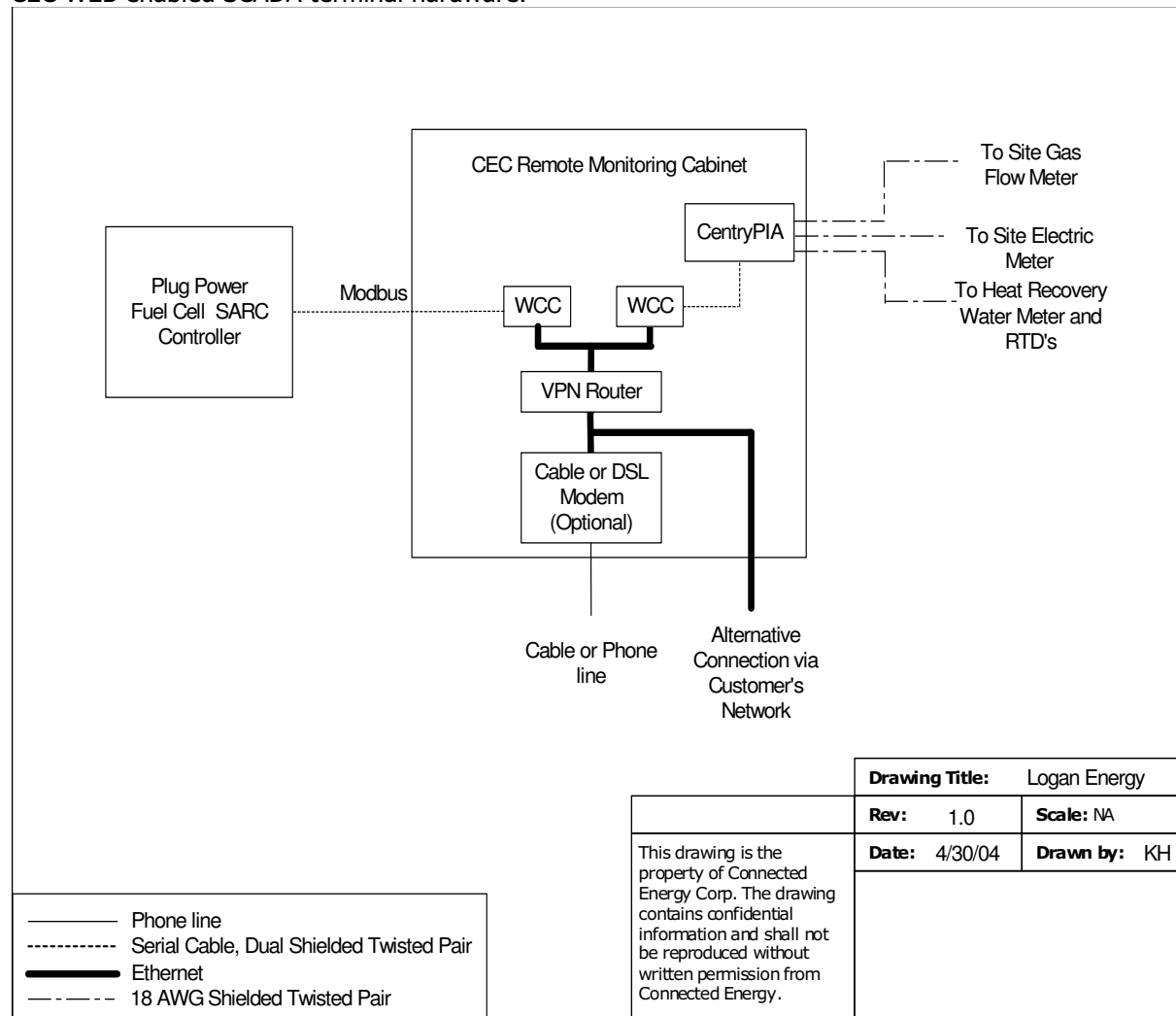
### Sierra Army Depot PEM Demonstration One-Line Diagram



## 11.0 Data Acquisition System

LOGAN proposes to install a Connected Energy Corporation web based SCADA system that provides high-speed access to real time monitoring of the power plant. The schematic drawing seen below describes the architecture of the CEC hardware that will support the project. The system provides a comprehensive data acquisition solution and also incorporates remote control, alarming, notification, and reporting functions. The system will pick up and display a number of fuel cell operating parameters on functional display screens including kWh, cell stack voltage, and water management, as well as external instrumentation inputs including Btus, fuel flow, and thermal loop temperatures. CEC's Operations Control Center in Rochester, New York maintains connectivity by means of a Virtual Private Network that will link the fuel cell to the center.

CEC WEB enabled SCADA terminal hardware.



LOGAN will procure high-speed Internet access to the fuel cell router from a local DSL or cable service provider. The base will provide local dial tone to a phone jack that will be conveniently located in the basement of Building #27 to provide communications with the fuel cell data modem.

## 12.0 Economic Analysis

### Sierra Army Depot, Herlong, CA

#### Estimated Project Utility Rates

1) Water (per 1,000 gallons)	\$	1.25
2) Utility (per KWH)	\$	0.068
3) LP Gas ( per gallon)	\$	1.00

#### Estimated First Cost

Plug Power 5 kW GenSys5C	\$	75,000.00
Shipping	\$	750.00
Installation electrical	\$	6,210.00
Installation mechanical	\$	10,094.00
Installation Thermal Recovery	\$	9,940.00
Web Communications Package	\$	11,925.00
Site Prep, labor, materials, general conditions	\$	2,775.00
SynDex Consulting	\$	3,500.00
Technical Supervision/Start-up	\$	2,800.00
Total	\$	122,994.00

#### Assume Five Year Simple Payback

\$ 24,598.80

#### Forecast Operating Expenses

	Gal/Hr		\$/Hr		\$/ Yr
LP Gas @ 2.5kWH	0.53	\$	0.53	\$	4,178.52
Water   Gals/Yr	4,918			\$	6.15
Total Annual Operating Costs				\$	4,184.67

#### Economic Summary

Forecast Annual kWH		19710
Annual Cost of Operating Power Plant	\$	0.212 kWH
Credit Annual Thermal Recovery	\$	0.029 kWH
Project Net Operating Cost	\$	0.183 kWH
Displaced Utility Cost (Increase) or Decrease	\$	(0.115) kWH
Project Energy Cost (Increase) or Decrease	\$	(2,275.78)

#### 13.0 Kickoff Meeting Information

The project kick-off meeting will take place at 10:00 AM on October 19, 2004 at Sierra Army Depot. Dr Mike Binder representing CERL and Sam Logan representing LOGANEnergy will join with Larry Duncan Sierra project POC and other stakeholders on the base to discuss the purpose and scope of the project. If there are any unresolved issues following the meeting, then the project will delay until they are resolved to the satisfaction of the parties. Before starting the project, Mr Duncan will report to Dr Binder that the base is ready to proceed.

#### 14.0 Status/Timeline

Please see Appendix 2 below.

## Appendix

1. Sample form used to qualify the fuel cell for initial start and the project acceptance test.

### **Installation/Acceptance Test Report**

Site: Sierra Army Depot

#### **Installation Check List**

<b>TASK</b>	<b>Initials</b>	<b>DATE</b>	<b>TIME (hrs)</b>
Batteries Installed	GC		
Stack Installed	GC		
Stack Coolant Installed	GC		
Air Purged from Stack Coolant	GC		
Radiator Coolant Installed	GC		
Air Purged from Radiator Coolant	GC		
J3 Cable Installed	GC		
J3 Cable Wiring Tested	GC		
Inverter Power Cable Installed	GC		
Inverter Power Polarity Correct	GC		
RS 232 /Modem Cable Installed	GC		
DI Solenoid Cable Installed with Diode	GC		
Natural Gas Pipe Installed	GC		
DI Water / Heat Trace Installed	GC		
Drain Tubing Installed	GC		

#### **Commissioning Check List and Acceptance Test**

<b>TASK</b>	<b>Initials</b>	<b>DATE</b>	<b>TIME (hrs)</b>
Controls Powered Up and Communication OK	GC		
SARC Name Correct	GC		
Start-Up Initiated	GC		
Coolant Leak Checked	GC		
Flammable Gas Leak Checked	GC		
Data Logging to Central Computer	GC		
System Run for 8 Hours with No Failures	GC		

## Appendix 2

### Sierra Army Depot PEM Fuel Cell Demonstration Project

Installation, Monitoring, Performance Evaluations, & Reproting on One Plug Power PEM Fuel Cell At Sierra Army Depot

Column Headings Indicate the Beginning of Each Month

